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ABSTRACT

The importance of specific academic skills for entering college students was assessed based on the views of 80 Indiana University faculty members who were teaching 100-level courses during the fall semester 1982-1983. Findings include the following: reading, reasoning, speaking/listening, and studying are academic skills judged necessary for success by the greatest number of faculty members teaching lower-division classes; 74 percent said that writing skills were relevant to success in their classes, while 36 percent said that mathematics skills were important for success; assignments in lower division classes involve mainly reading and, to a lesser extent, writing skills; nearly one-fourth of the respondents use essay examinations exclusively in their classes, 26 percent use objective tests only, and about one-third use a combination of essay and objective examinations; a greater number of writing skills were judged by the faculty to be essential for entering college freshmen than was found for the other basic skills. Information was obtained on essential skills in each of the areas (reading, writing, speaking/listening, reasoning, studying, and mathematics). (SW)

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# BASIC ACADEMIC SKILLS EXPECTED OF ENTERING FRESHMEN AT INDIANA UNIVERSITY

Lucy Cheser Jacobs

INDIANA STUDIES IN HIGHER EDUCATION
NUMBER FIFTY

U.S. DEPARTMENT OF EDUCATION
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BUREAU OF EVALUATIVE STUDIES AND TESTING
OFFICE OF THE DEAN OF THE FACULTIES
INDIANA UNIVERSITY
BLOOMINGTON, INDIANA

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This study surveyed 80 Indiana University faculty members who were teaching lower division (100-level) courses during the fall semester 1982. The faculty were asked to rate the importance of specific academic skills in reading, writing, speaking/listening, reasoning, studying, and mathematics for entering college students if they are to be successful in 100-level courses at Indiana University.

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## Introduction

Within recent years there has been a great deal of discussion concerning the deficiencies of college freshmen in the basic skills of reading, writing, and mathematics. Many administrators and faculty members feel that substantial numbers of students entering colleges and universities are not adequately prepared for college-level work. As a consequence, colleges and universities have had to offer an increasing number of remedial courses in order to bring entering freshmen up to college standards. In spite of the concern about declining skills, there has been little systematic effort to obtain college teachers' opinions regarding what they consider to be essential basic academic skills. One exception is the report by faculty members representing California's three public systems of higher education in which they specify the competencies that college-bound students are expected to have (Chronicle of Higher Education, December 2, 1981).

These representatives of the California system felt that "simply requiring students to complete a number of academic courses in high school in order to qualify for college admission is not sufficient." The level of performance required to complete three or four years of instruction in high school English and mathematics may not be the level of performance needed for success in college classes. Thus there is a need to identify the specific skills of verbal and mathematical literacy that are required for college-level work. If such information is communicated to the high schools, perhaps the content of high school courses can be strengthened and students more adequately prepared. A recent report from the Carnegie Foundation has also called for increased cooperation and joint decisions by high schools and colleges on the content of the secondary school curriculum and specifically the skills that students need for admission to college (Maeroff, 1983).

The purpose of the present study was to identify the specific skills and competencies that Indiana University faculty members consider to be basic and essential for all entering college students. The emphasis was on the basic intellectual skills that students should have in order to succeed in college. No attempt was made to inquire about the specific courses that students should take in high school. The present study is a follow-up to an earlier study (Jacobs, 1981) which found that a majority of Indiana University professors were not satisfied with freshman students' basic verbal and mathematical skills and believed that they had shown continuing decline.

## Methodology

A total of 108 faculty members who were teaching lower division (100-level) courses at Indiana University during the fall semester, 1982, was surveyed. The sample was drawn randomly from a list of all faculty members who were teaching lower division courses.

One hundred fourteen (114) items were written listing specific competencies in the areas of reading, writing, reasoning, mathematics,

speaking/listening and study skills.* These statements were examined by two reviewers who were asked to comment on the statement of the item, to suggest revisions, and to recommend other items for the questionnaire. The statements in the final form of the instrument were organized into the following sections: Reading, Writing, Speaking/Listening, Reasoning, Study Skills, and Mathematics. The mathematics skills were subdivided into Basic Arithmetic, Algebra I, Algebra II, Geometry, Trigonometry, Analytic Geometry and Mathematical Analysis, and Probability/Statistics. A copy of the questionnaire is available upon request.

Since all sections of the survey were not equally applicable to all professors, they were first asked to check the basic skills areas that they considered relevant to successful performance in their lower-division classes. For example, English professors were not expected to require mathematics skills nor chemistry professors writing skills. Then within each of the areas that they checked as relevant, the faculty member respondents were asked to rate each specific skills as: essential, somewhat important, or not at all important for freshman students when they come to the University.

The questionnaire was mailed to 108 faculty members at Indiana University-Bloomington (IUB) who were teaching 100-level courses. Eighty questionnaires were returned which represented a response rate of 75 percent. Among the respondents, 35 (or 44%) were from the humanities, 25 (or 31%) were from the social sciences, and 20 (or 25%) were from the natural sciences.

Each of the six basic skills areas was examined. The number and percentage of the total faculty sample giving each rating was determined. Although no precise scaling was assumed, numerical values from 1 (not at all important) to 3 (essential) were assigned to the response categories and a mean importance rating calculated for each basic skill. Faculty members were also instructed to list any additional skills that they considered important. A breakdown of mean ratings by Academic division is shown in the Appendix. Post hoc analysis was done on the means using the Scheffé procedure.

## Results

The number and percentage of respondents within the three academic divisions who indicated the relevance of each of the basic skills to performance in their classes are shown in Table 1.

Table 1 shows that reading, studying, reasoning, and speaking/listening are the basic skills that are considered most relevant to success in the lower-division classes. Writing was considered important in 74 percent of the respondents' classes, while only 36 percent of the respondents were concerned with mathematics. When the responses within

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*Many of the statements were taken from Statements on Preparation in English and Mathematics, the Academic Senates of the Calif. Community College, The Calif. State University and Colleges of the University of California, 1981.

Table 1. Relevance of basic skills areas to success in respondents' lower division classes by academic division (number and percentage).*

| Basic Skill Area | Humanities (N=35) | | Natural Sci. (N=20) | | Social Sci. (N=25) | | Total (N=80) | |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % |
| Reading | 34 | 97 | 17 | 85 | 25 | 100 | 76 | 95 |
| Writing | 34 | 97 | 4 | 20 | 21 | 84 | 59 | 74 |
| Mathematics | 0 | 0 | 17 | 85 | 12 | 48 | 29 | 36 |
| Reasoning | 30 | 86 | 19 | 95 | 23 | 92 | 72 | 90 |
| Speaking/Listening | 31 | 89 | 13 | 65 | 23 | 92 | 67 | 84 |
| Study Skills | 31 | 89 | 17 | 85 | 25 | 100 | 73 | 91 |

*Percentage of N within each of the academic divisions.

the three academic divisions are examined, however, it can be seen that 97 percent of the respondents in the humanities and 84 percent in the social sciences say that writing skills are necessary to successful performance in their classes. While no respondent in the humanities was concerned with students' mathematics skills, almost half of the social scientists surveyed say that mathematics skills are relevant to success in their classes. The faculty members in the natural sciences are especially interested in students' mathematics and reasoning skills.

In order to gain further insight into the extent of demand for verbal and mathematical skills in lower division classes, the respondents were asked about the type of assignments typically required in their classes. Table 2 shows a breakdown of the responses by academic division.

Table 2. Type of assignments typically required in lower division classes by academic division (number and percentage).

| Assignment | Humanities (N=35) | | Natural Sci. (N=20) | | Social Sci. (N=25) | | Total (N=80) | |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | | % |
| Reading Only | 4 | 11 | 4 | 20 | 7 | 28 | 15 | 19 |
| Reading and Writing: Themes/Essays | 12 | 34 | 0 | 0 | 5 | 20 | 17 | 21 |
| Reading and Writing: Research Papers | 2 | 6 | 0 | 0 | 3 | 12 | 5 | 6 |
| Reading and Writing Lab Reports | 2 | 6 | 3 | 15 | 0 | 0 | 5 | 6 |
| Reading and Writing: Themes/Essays and Research Papers | 9 | 26 | 0 | 0 | 3 | 12 | 12 | 15 |
| Reading and Mathematics | 0 | 0 | 8 | 40 | 1 | 4 | 9 | 11 |
| Reading and Other* | 6 | 17 | 4 | 20 | 4 | 16 | 14 | 18 |
| Reading, Mathematics, and Other | 0 | 0 | 1 | 5 | 2 | 8 | 3 | 4 |

*Other assignments listed include creative writing (poems, short stories), oral presentations, bibliographies, mapwork, language lab.

Predictably, reading is involved in all types of assignments. Some form of writing is required in over half of the respondents' classes. The demand for writing skills is greatest in the humanities followed by the social sciences. Themes, essays, and research papers represent the major type of written assignments. Assignments involving mathematics are restricted to the natural sciences and to a lesser extent the social sciences.

Some types of examinations also require writing skills. Therefore, the respondents were asked about the type of examinations they typically used in their lower-division classes. It can be seen in Table 3 that essay tests are the only form of exam in almost one-fourth of the respondents' classes. Approximately one-third of the faculty members surveyed use a combination of essay and objective tests. The essay exam is especially popular in the humanities. The objective test is most widely used in the natural sciences. The social scientists are about evenly divided in their use of essay and objective tests.

Table 3. Type of examinations typically used in lower division classes by academic division (number and percentage).

| Type of Examination | Humanities (N=35) | | Natural Sci. (N=20) | | Social Sci. (N=25) | | Total (N=80) | |
|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % |
| Essay Only | 11 | 31 | 1 | 5 | 6 | 24 | 18 | 23 |
| Objective Only | 5 | 14 | 10 | 50 | 6 | 24 | 21 | 26 |
| Both Essay and Objective | 8 | 23 | 6 | 30 | 13 | 52 | 27 | 34 |
| Other* | 9 | 25 | 3 | 15 | 0 | 0 | 12 | 15 |
| No Tests | 2 | 6 | 0 | 0 | 0 | 0 | 2 | 2 |

*Other types include listening comprehension, speaking, oral questions, problem-solving, etc.

Each of the basic skills areas was analyzed in greater detail.

## READING

It was seen in Table 1 that almost all (76 or 95 percent) of the faculty members regarded reading as a basic skill necessary for success in their University classes. The respondents were asked to rate the importance of a number of specific reading skills for entering freshmen. Table 4 shows that no reading skill received a mean importance rating lower than 2.0. The two most important reading skills are the ability to understand concepts presented in written text and the ability to identify and comprehend the main and subordinate ideas in written text. These skills were rated as essential by 93 and 83 percent of the respondents respectively. There was no other reading skill rated as essential by a majority of the professors. However, approximately one-half thought that the ability to summarize ideas from written text in one's own words, the ability to separate one's personal opinions from a writer's opinions and the ability to use various means to define unfamiliar words were also essential reading skills. Other reading skills

mentioned were the ability to define the focus of an assigned text without getting lost on details and the ability to know when one does not understand reading material and to ask questions about the problem. The ability to read tables, charts, and graphs was also another reading skill considered important for college-bound students. Overall, respondents believed that competencies such as the ability to identify a writer's point of view and tone, the ability to recognize different purposes and methods of writing and reading speed are somewhat less important. However, when the responses for academic divisions were compared (see Appendix 1A), it was found that the respondents in the humanities and in the social sciences considered the latter skills significantly more important than did the respondents in the natural sciences.

Table 4. Priorities assigned by respondents to specific reading skills* N-76 (percentages).

| Skill | Not at All Important | Somewhat Important | Essential | Mean |
|---|---|---|---|---|
| *The ability to* | | | | |
| 1 understand concepts presented in written text | 1 | 5 | 93 | 2.9 |
| 2 identify the main and subordinate ideas | 3 | 15 | 83 | 2.8 |
| 3 summarize the ideas in one's own words | 12 | 38 | 50 | 2.4 |
| 4 recognize different purposes and methods of writing | 30 | 43 | 26 | 2.0 |
| 5 identify a writer's point of view and tone | 37 | 30 | 33 | 2.0 |
| 6 vary reading speed and methods to the type of material | 22 | 50 | 28 | 2.1 |
| 7 separate personal opinions from a writer's opinions | 17 | 34 | 49 | 2.3 |
| 8 use the different features of books and reference material | 18 | 46 | 36 | 2.2 |
| 9 define unfamiliar words by decoding, using contextual clues, or dictionary | 9 | 42 | 49 | 2.4 |

*All of the basic skill statements contained in the tables have been paraphrased in order to conserve space.

## WRITING

Fifty-nine (approximately 75 percent) of the faculty members surveyed indicated that writing skills were necessary for students' successful performance in their classes. Of this number, 21 (36%) were from the social sciences, 4 (6%) were from the natural sciences, and 34 (58%) were from the humanities. Table 5, which shows the ratings of the 59 respondents, indicates that 12 of the skills were rated as essential by a majority of the respondents. The single most important writing skill that faculty members expect of entering freshmen is the ability to write logical,

Table 5. Priorities assigned by respondents to specific writing skills N=59 (percentages).

| Skill | Not at All Important | Somewhat Important | Essential | Mean |
|---|---|---|---|---|
| *The ability to* | | | | |
| 1 generate ideas about which to write | 22 | 32 | 46 | 2.2 |
| 2 formulate a thesis statement | 25 | 22 | 53 | 2.3 |
| 3 select and organize material to develop thesis | 25 | 25 | 59 | 2.4 |
| 4 prepare an outline | 22 | 32 | 46 | 2.2 |
| 5 construct a well developed paragraph | 9 | 20 | 71 | 2.6 |
| 6 write different types of paragraphs | 15 | 41 | 44 | 2.3 |
| 7 make clear transitions between paragraphs | 14 | 27 | 59 | 2.5 |
| 8 construct sentences of varied types | 18 | 31 | 51 | 2.3 |
| 9 write grammatically correct, logical sentences | 5 | 10 | 85 | 2.8 |
| 10 support one's opinions with appropriate evidence | 5 | 14 | 81 | 2.7 |
| 11 use precise and appropriate words in sentences | 5 | 44 | 51 | 2.5 |
| 12 vary one's vocabulary and sentences for different audiences | 27 | 42 | 31 | 2.0 |
| 13 synthesize information from different sources | 15 | 39 | 46 | 2.3 |
| 14 present own ideas related to but clearly distinguished from others | 24 | 32 | 44 | 2.2 |
| 15 distinguish between plagiarism and documentation | 19 | 17 | 64 | 2.5 |
| 16 provide adequate documentation | 37 | 34 | 29 | 1.9 |
| 17 use a dictionary | 9 | 49 | 42 | 2.3 |
| 18 use library resources efficiently | 31 | 42 | 27 | 2.0 |
| 19 identify and locate appropriate reference books | 35 | 36 | 29 | 1.9 |
| 20 follow the conventions of standard written English | 10 | 20 | 70 | 2.6 |
| 21 critically assess and revise one's writing | 10 | 32 | 58 | 2.5 |
| 22 proofread one's writing for mechanical errors and omissions of form | 7 | 39 | 54 | 2.5 |

coherent and grammatically correct sentences. Also considered essential is the ability to formulate a thesis statement and to develop or defend the thesis in well-organized paragraphs. Students are expected to be able to use precise and correct words in their writing and to support opinions with the appropriate evidence. Faculty believe it is essential that students know the conventions of standard written English and are able to critically assess the organization and quality of their writing, and to revise and rewrite accordingly. At least one-third of the faculty

members feel that writing skills such as knowing how to provide documentation in the form of footnotes or endnotes, identifying and locating reference books and using library resources are somewhat important but not really essential skills for entering freshmen. Another writing skill not included in the list to be rated but mentioned by some respondents as important was the ability to express original ideas or to give writing an original slant.

A breakdown by academic division (Appendix 2A) revealed that the respondents in the humanities gave higher importance ratings to most of the writing skills. The ratings were significantly higher on the skills relating to proofreading, evaluating one's writing, revising and rewriting.

## SPEAKING-LISTENING

Sixty-seven (84 percent) of the faculty members surveyed considered speaking/listening skills relevant to success in their classes (see Table 1). Almost one-half (N=31) of this number was from the humanities, 19 percent (N=13) were from the natural sciences, and 34 percent (N=23) were from the social sciences. The overall ratings of specific speaking/listening skills are shown in Table 6. The faculty member respondents were almost unanimous in rating the ability to identify and comprehend the main and subordinate ideas in lectures and discussions as an essential basic skill for entering freshmen. Other skills considered essential by a majority of respondents were the ability to ask and answer questions coherently and concisely, the ability to follow spoken instructions and the ability to critically and constructively exchange ideas during discussions in class or with the instructor. The ability to engage in the exchange of ideas during class is significantly more important in the humanities and in the social sciences than in the natural sciences. Overall, few of the respondents rate the ability to develop and to deliver a presentation before a group as an essential basic skill for college freshmen. When the responses for the academic divisions were compared (see Appendix 3A), however, it was found that the latter skills are considered somewhat more important in the humanities than in the other two divisions.

Table 6. Priorities assigned by respondents to speaking/listening skills N=67 (percentages).

| Skill | Not at All Important | Somewhat Important | Essential | Mean |
|---|---|---|---|---|
| *The ability to* | | | | |
| 1 engage in exchange of ideas during class discussions | 13 | 34 | 52 | 2.4 |
| 2 ask and answer questions coherently | 3 | 28 | 69 | 2.7 |
| 3 follow spoken instructions | 5 | 28 | 67 | 2.6 |
| 4 identify and comprehend ideas in lectures and discussions | 3 | 4 | 93 | 2.9 |
| 5 develop a topic for presentation to a group | 48 | 34 | 18 | 1.7 |
| 6 make a clear presentation of one's ideas to a group | 39 | 40 | 21 | 1.8 |

## REASONING

Reasoning skills were judged to be relevant to successful performance in the classes of 72 (90 percent) of the respondents (see Table 1). Twenty-three (32 percent) of these were from the social sciences, 19 (26 percent) from the natural sciences, and 30 (or 42 percent) from the humanities. Table 7 shows that the reasoning skills which a majority of the faculty members considered essential are the ability to recognize fallacies in reasoning and to draw conclusions from written or spoken information, the ability to comprehend and use concepts/generalizations, the ability to distinguish between fact and opinion, and the ability to use inductive and/or deductive reasoning. The latter skill was most important in the natural sciences. There were some noticeable differences among the groups in the ratings assigned to the reasoning skills (see Appendix 4A). The respondents in the natural sciences gave a higher importance rating to the ability to "draw conclusions from information presented in tabular or graphic form." The faculty in the social sciences gave a higher rating than did the others to the ability to "comprehend, develop, and use concepts and generalizations." Less important reasoning skills for entering freshmen are the ability to formulate problems and their solutions, the ability to state and test hypotheses, and the ability to assess completeness or accuracy of information. These skills received mean ratings on the importance scale of 2.1, 1.9, and 2.2 respectively. Another reasoning skill listed was the ability to take abstract information and "make that information make sense."

Table 7. Priorities assigned by respondents to reasoning skills, N=72 (percentages).

| Skill | Not at All Important | Somewhat Important | Essential | Mean |
|---|---|---|---|---|
| *The ability to* | | | | |
| 1 recognize and use inductive and/or deductive reasoning | 4 | 40 | 56 | 2.5 |
| 2 recognize fallacies in reasoning | 11 | 38 | 51 | 2.4 |
| 3 draw conclusions from written/ spoken information | 3 | 18 | 79 | 2.8 |
| 4 draw conclusions from tabular or graphic information | 25 | 25 | 50 | 2.3 |
| 5 comprehend, develop, and use concepts and generalizations | 4 | 24 | 72 | 2.7 |
| 6 distinguish between fact and opinion | 11 | 25 | 64 | 2.5 |
| 7 identify problems along with proposed solutions | 22 | 42 | 36 | 2.1 |
| 8 state hypotheses from partial information and test hypotheses | 37 | 39 | 24 | 1.9 |
| 9 assess completeness or adequacy of information | 18 | 44 | 38 | 2.2 |
| 10 distinguish between observation and inference | 15 | 47 | 38 | 2.2 |

## STUDY SKILLS

Twenty-four (33 percent) of respondents from the social sciences, 18 (25 percent) from the natural sciences and 31 (42 percent) from the humanities rated study skills. Table 8 shows that most of the study skills listed were considered essential by the majority of these faculty members. Freshmen students are expected to be able to identify and comprehend the main ideas in lectures, to be able to take notes on lectures, to follow instructions for assignments and to set priorities and schedules for study. Sixty percent of the respondents felt that students should know how to prepare for and take various types of exams. The least important study skills were the ability to interact with peers in study groups and the ability to locate and use external resources such as computers, interviews, direct observations, etc., in the learning process. In spite of the increased emphasis on computer education in the high schools, professors do not at this time expect entering students to have computer skills. A break-down of the mean ratings by academic division (Appendix 5A) showed, however, that the ability to use various resources was considered significantly more important to successful performance in the humanities as was the ability to accept constructive criticism and learn from it.

Table 8. Priorities assigned by respondents to specific study skills, N=73 (percentages).

| Skill | Not at All Important | Somewhat Important | Essential | Mean |
|---|---|---|---|---|
| *The ability to* | | | | |
| 1 set study goals and priorities | 5 | 25 | 70 | 2.6 |
| 2 establish surroundings and habits conducive to learning | 4 | 32 | 64 | 2.6 |
| 3 identify important points in a lecture and take notes | 2 | 18 | 80 | 2.8 |
| 4 follow a study schedule | 5 | 37 | 58 | 2.5 |
| 5 interact with peers in study groups | 26 | 38 | 36 | 2.1 |
| 6 use resources such as computers, library to facilitate learning | 31 | 43 | 26 | 1.9 |
| 7 develop general and specialized vocabularies | 12 | 40 | 48 | 2.4 |
| 8 follow instructions for academic assignments | 7 | 19 | 74 | 2.7 |
| 9 comprehend and report main ideas from lectures, reading | 4 | 15 | 81 | 2.8 |
| 10 apply knowledge to new situations | 8 | 26 | 66 | 2.6 |
| 11 prepare for and take various types of examinations | 11 | 29 | 60 | 2.5 |
| 12 accept constructive criticism and learn from it | 15 | 33 | 52 | 2.4 |

## MATHEMATICS

The last skill to be examined was mathematics. Only 29 (36 percent) of the 80 respondents checked mathematics skills as requisite for success in their classes. These respondents were either from the social sciences (N=12) or the natural sciences (N=17). Respondents were asked to rate the importance of specific skills typically developed in the various mathematics courses. The first area to be considered was basic arithmetic. The ratings given to the importance of basic arithmetic skills are shown in Table 9.

Table 9. Priorities assigned by respondents to specific basic arithmetic skills, N=29 (percentages).

| Skill | Not at All Important | Somewhat Important | Essential | Mean |
|---|---|---|---|---|
| *The ability to* | | | | |
| 1 perform computations with whole numbers | 7 | 10 | 83 | 2.8 |
| 2 apply percents | 7 | 14 | 79 | 2.7 |
| 3 translate verbal problems into mathematical statements | 7 | 38 | 55 | 2.5 |
| 4 round off and approximate numbers | 24 | 24 | 52 | 2.3 |
| 5 solve problems having exponents and square roots | 21 | 29 | 50 | 2.2 |
| 6 use and interpret graphs and tables | 0 | 17 | 83 | 2.8 |
| 7 understand and use basic arithmetic properties | 3 | 10 | 86 | 2.8 |

Most of the basic arithmetic skills were considered essential by a great majority of the 29 respondents. That is, those faculty concerned at all with mathematics in their classes expect freshmen to have basic arithmetic skills if they are to perform successfully in lower division classes. There were some significant differences in the responses of faculty members in the two academic divisions (see Appendix 6A). Respondents in the natural sciences thought that skills such as the ability to translate verbal problems into mathematic statements, the ability to round off and approximate numbers and the ability to solve problems having exponents and square roots were significantly more important skills for entering freshmen. The faculty members in the social sciences assigned more importance to simply being able to perform computations with whole numbers.

The ratings assigned to beginning algebra skills are shown in Table 10. The mean ratings indicate that algebra skills are considered less important for lower division classes than are basic arithmetic skills. The beginning algebra skills judged as essential for entering freshmen by a majority of the 29 respondents were: the ability to perform arithmetic operations with literal symbols, the ability to work with ratios and proportions, and the ability to solve elementary word problems.

Table 10. Priorities assigned by respondents to specific beginning algebra skills, N=29 (percentages).

| Skill | Not at All Important | Somewhat Important | Essential | Mean |
|---|---|---|---|---|
| *The ability to* | | | | |
| 1 perform arithmetic operations with literal symbols | 21 | 17 | 62 | 2.4 |
| 2 solve linear equations | 31 | 24 | 45 | 2.1 |
| 3 work with ratios and proportions | 21 | 17 | 62 | 2.4 |
| 4 perform operations with integer exponents | 34 | 17 | 48 | 2.1 |
| 5 perform operations with polynomials and rational expression | 58 | 14 | 28 | 1.7 |
| 6 factor | 52 | 17 | 31 | 1.8 |
| 7 solve quadratic equations | 65 | 14 | 21 | 1.6 |
| 8 use formulas to find area and perimeter of geometric figures | 48 | 24 | 28 | 1.8 |
| 9 solve elementary word problems | 31 | 17 | 52 | 2.2 |

The least important beginning algebra skills (rated as "not at all important" by a majority of the respondents) are the ability to solve quadratic equations, perform operations with polynomials and rational expressions, and to factor. Most of these beginning algebra skills were assigned significantly more importance by respondents in the natural sciences.

Table 11. Priorities assigned by respondents to specific advanced algebra skills, N=29 (percentages).

| Skill | Not at All Important | Somewhat Important | Essential | Mean |
|---|---|---|---|---|
| *The ability to* | | | | |
| 1 understand fractional exponents, radicals and the properties of roots | 72 | 7 | 21 | 1.5 |
| 2 solve linear and quadratic inequalities and equations with rational expressions | 72 | 14 | 14 | 1.4 |
| 3 understand the binomial theorem | 79 | 21 | 0 | 1.2 |
| 4 graph linear and quadratic functions and inequalities and determine slopes | 55 | 28 | 17 | 1.6 |
| 5 solve systems of linear equations with two or three unknowns | 76 | 14 | 10 | 1.3 |
| 6 understand arithmetic and geometric sequences | 76 | 24 | 0 | 1.2 |
| 7 understand the function concept, including compositions and inverse functions | 62 | 14 | 24 | 1.C |
| 8 solve word problems using all of the above concepts | 72 | 7 | 21 | 1.5 |

Table 11 indicates that a great majority of the 29 respondents rated all of the Algebra II skills as "not at all important" for college freshmen. The one skill rated as essential by the largest number (24 percent) is the ability to understand the concept of functions.

Similarly, few of the respondents consider geometry skills as essential for freshmen's successful performance in their classes. Table 12 shows that 28 percent (the highest) of the 29 respondents believed that it is essential for students to be able to apply formulas for areas, volumes, and perimeters. But not a single respondent considered "the ability to offer proofs of geometric theorems" as an essential skill for college freshmen. Low mean importance ratings were assigned to other geometry skills.

Table 12. Priorities assigned by respondents to specific geometry skills, N=29 (percentages).

| Skill | Not at All Important | Somewhat Important | Essential | Mean |
|---|---|---|---|---|
| *The ability to* | | | | |
| 1 Apply formulas for areas, volumes, and perimeters | 62 | 10 | 28 | 1.7 |
| 2 solve problems involving geometric figures | 69 | 17 | 14 | 1.4 |
| 3 apply the Pythagorean theorem to solve problems | 62 | 21 | 17 | 1.6 |
| 4 understand and use the basic postulate of Euclidean geometry | 59 | 34 | 7 | 1.5 |
| 5 offer proofs of the major geometric theorems | 93 | 7 | 0 | 1.1 |
| 6 knowledge of coordinate geometry | 94 | 3 | 3 | 1.1 |

Trigonometry skills were also rated and the results are shown in Table 13. The low mean ratings indicate that the great majority of the 29 respondents believed that trigonometry skills are not essential for entering college freshmen. Only one competency (the ability to solve right triangles) was considered "somewhat important" by more than one-fourth of the respondents. The remaining skills were rated as "not at all important" by a majority of the respondents.

Table 14 shows the ratings assigned by the respondents to skills in analytic geometry and mathematical analyses. An understanding of elementary linear algebra was considered essential for entering college freshmen by 10 percent of the 29 respondents. All of the other skills were rated as essential by only one respondent. Approximately one-fourth of the respondents thought that an understanding of mathematical induction and of lines and planes in space was "somewhat important for entering college students. The remaining skills were judged to be not at all important.

Table 13. Priorities assigned by respondents to specific trigonometry skills, N=29 (percentages).

| Skill | Not at All Important | Somewhat Important | Essential | Mean |
|---|---|---|---|---|
| *An understanding of* | | | | |
| 1 laws of sines and cosines, and solutions of oblique triangles | 80 | 17 | 3 | 1.2 |
| 2 solution of trigonometric equations | 80 | 17 | 3 | 1.2 |
| 3 trigonometric form of complex numbers and deMoivre's theorem | 93 | 7 | 0 | 1.1 |
| 4 polar coordinates and vectors | 86 | 14 | 0 | 1.1 |
| 5 trigonometric functions as ratios of length of sides of triangles and as circular functions | 83 | 14 | 3 | 1.2 |
| 6 graphical characteristics of trigonometric functions | 87 | 10 | 3 | 1.2 |
| 7 solution of right triangles | 69 | 31 | 0 | 1.3 |
| 8 radian and degree measure | 76 | 17 | 7 | 1.3 |
| 9 trigonometric identities | 90 | 7 | 3 | 1.1 |
| 10 trigonometric functions | 80 | 17 | 3 | 1.2 |
| 11 inverse trigonometric functions and their graphs | 94 | 3 | 3 | 1.1 |

Table 14. Priorities assigned by respondents to specific competencies in analytic geometry and mathematical analysis, N=29 (percentages).

| Skill | Not at All Important | Somewhat Important | Essential | Mean |
|---|---|---|---|---|
| *An understanding of* | | | | |
| 1 coordinate geometry including treatment of conic system | 94 | 3 | 3 | 1.1 |
| 2 rational functions and their graphs | 83 | 14 | 3 | 1.2 |
| 3 elementary functions and their inverses and graphs | 80 | 17 | 3 | 1.2 |
| 4 polar coordinates and vectors | 83 | 17 | 0 | 1.2 |
| 5 graphing in polar coordinates and vectors | 93 | 7 | 0 | 1.1 |
| 6 elementary linear algebra | 69 | 21 | 10 | 1.4 |
| 7 mathematical induction | 76 | 24 | 0 | 1.2 |
| 8 parametric equations and their graphs | 94 | 3 | 3 | 1.1 |
| 9 lines and planes in space; three dimensional figures | 76 | 21 | 3 | 1.3 |

While a majority of the respondents did not feel that statistics and probability skills are important for entering college freshmen, Table 15 shows that a small percentage of the 29 respondents believed that an understanding of descriptive statistics and of probability is essential or at least somewhat important.

Table 15. Priorities assigned to specific competencies in probability and statistics, N=29 (percentages).

| Skill | Not at All Important | Somewhat Important | Essential | Mean |
|---|---|---|---|---|
| *An understanding of* | | | | |
| 1 descriptive statistics: frequency distributions, central tendency and variability | 55 | 28 | 17 | 1.6 |
| 2 probability | 59 | 24 | 17 | 1.6 |
| 3 distributions: binomial and normal | 79 | 14 | 7 | 1.3 |
| 4 regression and correlation | 72 | 21 | 7 | 1.3 |
| 5 statistical inference: sampling distributions, confidence intervals, hypothesis testing | 76 | 17 | 7 | 1.3 |

Table 16 summarizes the overall mean importance ratings given to the various basic skills by faculty members in the three academic divisions.

Table 16. Summary of mean importance rating of basic skills areas to success in lower division classes by academic division.

| Area | Academic Division | Mean | Area | Academic Division | Mean |
|---|---|---|---|---|---|
| Reading | Humanities | 2.4 | Beginning Algebra | Natural Science | 2.6 |
| | Natural Science | 2.0 | | Social Science | 2.1 |
| | Social Science | 2.7 | Algebra II | Natural Science | 2.2 |
| *Writing | Humanities | 2.4 | | Social Science | 1.8 |
| | Social Science | 2.2 | Reasoning | Humanities | 2.3 |
| Speaking/ Listening | Humanities | 2.5 | | Natural Science | 2.4 |
| | Natural Science | 2.2 | | Social Science | 2.4 |
| | Social Science | 2.3 | Study Skills | Humanities | 2.5 |
| **Basic Arithmetic | Natural Science | 2.8 | | Natural Science | 2.4 |
| | Social Science | 2.4 | | Social Science | 2.4 |

* Mean for Natural Science Division not shown since N=4.
** Mean for Humanities not shown since N=0

Table 16 indicates that the faculty members in the humanities considered reading, writing, speaking/listening, and studying the skills most important for entering freshmen if they are to be successful in their lower-level classes. Respondents from the social sciences considered reading, reasoning, basic arithmetic and study skills the most important. Basic mathematics, beginning algebra, reasoning, and studying are the skills most important to performance in the natural sciences. There were no significant differences, however, in the mean importance ratings assigned to any of the basic skill areas by faculty members in the three academic divisions.

## SUMMARY

This study surveyed 80 Indiana University faculty members who were teaching 100-level courses during the fall semester 1982-83. The faculty members were asked to rate the importance of a number of specific academic skills for freshman students' successful performance in their respective classes. They were directed to consider the importance of these skills for students when they enter the University. The major findings were:

1. Reading, Reasoning, Speaking/Listening, and Studying are academic skills judged necessary for success by the greatest number of faculty members teaching lower division classes. Seventy-four percent said that writing skills were relevant to success in their classes; 36 percent said that mathematics skills were important for success.

2. Assignments in lower division classes involve mainly reading and, to a lesser extent, writing skills. Mathematic skills were in least demand in these classes.

3. Nearly one-fourth of the respondents use essay examinations exclusively in their classes; 26 percent use objective tests only and approximately one-third use a combination of essay and objective examinations.

4. The reading skills that were judged <u>essential</u> by the greatest number of respondents were:

   a) the ability to understand concepts presented in written text.
   b) the ability to identify and comprehend the main and subordinate ideas in written text.

Somewhat <u>less important</u> were:

   c) the ability to summarize the ideas contained in written text in one's own words.
   d) the ability to define unfamiliar words by decoding or by using contextual clues or a dictionary.

Approximately one-third of the respondents felt that the ability to recognize different purposes and methods of writing and the ability to identify a writer's point of view and tone were <u>not at all important</u> skills for entering freshman students. Respondents from the humanities and the social sciences gave higher mean importance ratings to most of the reading skills than did the respondents from the natural sciences.

5. A greater number of writing skills were judged by the faculty to be essential for entering college freshmen than was found for the other basic skills. The essential writing skills were the ability to:

a) formulate a thesis statement.
b) select and organize material to develop the thesis.
c) construct a well developed paragraph with main idea plus examples/reasons.
d) make clear transitions between paragraphs so that a logical relationship is drawn.
e) write sentences that are not only grammatically correct but also logical and coherent.
f) support one's opinions or conclusions with the appropriate use of evidence.
g) distinguish between plagiarism and documentation.
h) follow the conventions of standard written English and of mechanics.
i) critically assess one's writing (organization, evidence, etc.) and revise, restructure, and rewrite accordingly.
j) proofread one's writing for mechanical errors and omissions and make the necessary corrections.

The respondents in the humanities gave higher importance ratings to most of the writing skills.

6. Certain speaking/listening skills were judged to be essential. These were the ability to:

a) engage critically and constructively in the exchange of ideas during class discussions and conferences with instructors.
b) ask questions and answer questions coherently and concisely.
c) follow spoken instructions.
d) identify and comprehend the main and subordinate ideas in lectures and discussions.

The ability to conceive and develop ideas for an oral presentation and the ability to actually make a presentation before a group were judged not to be essential skills for all entering freshmen. However, these two skills were judged to be more important in the humanities than in the other two divisions.

7. The majority of faculty members rated the following reasoning skills as essential for entering college students: The ability to

a) draw reasonable conclusions from information presented in written/spoken form.
b) comprehend, develop, and use concepts and generalizations.
c) distinguish between fact and opinion.
d) recognize and use inductive and/or deductive reasoning.
e) recognize fallacies in reasoning.

The faculty members did not tend to believe that reasoning skills such as the ability to identify and formulate problems and propose ways to solve the problems, the ability to state hypotheses and test the hypotheses or the ability to distinguish between observation and inference were essential for entering freshman students.

The ability to recognize and use inductive and/or deductive reasoning was the single most important reasoning skills according to respondents in the natural sciences. The ability to comprehend and use

concepts and generalizations was the most important in the social sciences, while the ability to draw conclusions from written/spoken information was the most important reasoning skill for the humanities.

8. Most study skills were considered essential for entering college students. The study skills considered least important were the ability to interact and learn from peers in study groups and the ability to locate and use external resources such as computers, libraries, interviews, direct observation, etc., in the learning process.

9. Only 29 of the respondents (all from the natural sciences and social sciences) considered mathematics skills as necessary to success in their 100-level classes. A majority of these respondents considered the following basic arithmetic skills as essential for entering college freshmen: The ability to

a) understand and use basic arithmetic properties.
b) use and interpret graphs and tables.
c) perform computations with numbers.
d) apply percents.
e) translate verbal problems into mathematical statements.
f) round off and approximate numbers.

10. Only a few beginning algebra skills were rated as essential by a majority of the respondents. The essential skills were the ability to perform arithmetic operations with literal symbols, the ability to work with ratios and proportions and the ability to solve elementary word problems.

A majority of the respondents said that skills such as the ability to perform operations with polynomials and rational expressions, the ability to solve quadratic equations and the ability to factor were "not at all important" for entering college students.

11. There were no other mathematics skills rated as essential for entering college students by any sizable number of respondents. Skills in advanced algebra, geometry, trigonometry, analytic geometry, and statistics/probability tended to be regarded as not important for students to have when they enter the University.

## CONCLUSIONS

Certain academic skills are considered requisite if students are to be able to take advantage of the learning opportunities offered by a college education. Faculty members at Indiana University expect entering freshman students to have skills and competencies in English, reading, reasoning, speaking/listening, studying and mathematics if they are to be successful in college-level courses. These are skills that students should have when they enter the University. Hence, this study has defined skills that should be taught and developed in the high school. If entering college students do not have these competencies, it often becomes necessary to overcome the deficiencies through remedial coursework.

The major conclusions are:

1. Students must develop writing skills before entering college. They will be required to write themes, essays, term papers, as well as essay examinations. Writing skills are especially important for successful performance in the humanities and the social sciences.

The development of writing skills will be promoted most by having extensive writing requirements in high school. Students should be taught how to state a thesis, select and organize material and write in a way that is not only logical and coherent but also grammatically correct. It is also important that high school students have experience in making critical assessments of their own work to be followed by revision, rewriting, and polishing of the product.

2. Reading skills are important to successful performance in any type of undergraduate program. Students must have the opportunity to develop good reading skills in high school. They should have the ability to read with understanding a wide variety of literature. They will need to have proficiency in information-gatherine, analysis and criticism. Since the level of reading requirements in college is greater than in high school, students should have experience in looking up the meaning of words they do not understand and in analyzing and evaluating what they read.

3. Speaking/Listening skills are requisite to success in college. Students should have an opportunity in high school to engage critically in the exchange of ideas and to ask and answer questions coherently and concisely. Being able to follow spoken instructions is an expected competency.

4. Well-developed reasoning skills represent another competency expected of entering college freshmen. The ability to reason is important for success in courses, especially in the natural sciences.

5. Students need to learn how to study in high school. They will be expected in college to know how to identify the main points in lectures and in readings, how to take notes and how to set a study schedule so that assignments are completed on time. It is also very important that students have experience in preparing for and taking different types of examinations, especially essay exams.

6. The extent of preparation in mathematics needed by entering freshmen will depend upon the course of study. Proficiency in mathematics is especially important in the natural sciences and in the social sciences. Students planning to take lower-division courses in these areas should master the skills and techniques of basic mathematics and at least elementary algebra.

7. It is recommended that investigations be conducted by other colleges and universities on the academic skills needed by entering students. Such studies will be of mutual benefit to both the secondary schools and the institutions of higher education.

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# APPENDIX

Table 1A. Mean rating of the importance of specific reading skills for entering freshmen by academic division.

| READING SKILLS | Humanities N=34 | Natural Sciences N=17 | Social Sciences N=25 |
|---|---|---|---|
| *The ability to* | | | |
| 1 understand concepts presented in written text | 2.9 | 2.9 | 3.0 |
| 2 identify and comprehend the main and subordinate ideas in written text | 2.9 | 2.6 | 2.9 |
| 3 summarize the ideas contained in written text in one's own words | 2.4 | 2.4 | 2.4 |
| 4 recognize different purposes and methods of writing | 2.3 | 1.3 | 2.0* |
| 5 identify a writer's point of view and tone, and interpret a writer's meaning inferentially as well as literally | 2.3 | 1.2 | 2.0* |
| 6 vary one's reading speed and methods (survey, skim, review, question, and master) according to the type of material and one's purpose for reading | 2.1 | 1.8 | 2.2 |
| 7 separate one's personal opinions and assumptions from a writer's opinions and assumptions | 2.6 | 1.6 | 2.5* |
| 8 use such features of books and other reference materials as the preface, introduction, table of contents, glossary, index, appendix, and bibliography | 2.1 | 2.2 | 2.2 |
| 9 define unfamiliar words by decoding, using contextual clues, or by using a dictionary | 2.5 | 2.1 | 2.4 |

*Humanities and Social Sciences differ significantly from Natural Sciences $p<.05$

Table 2A. Mean rating of the importance of specific writing skills for entering freshmen by academic division.*

| WRITING SKILLS | Humanities N=34 | Social Sciences N=21 |
|---|---|---|
| *The ability to* | | |
| 1 generate ideas about which to write. | 2.3 | 2.1 |
| 2 formulate a thesis statement. | 2.4 | 2.2 |
| 3 select and organize material that will develop or defend the thesis. | 2.5 | 2.4 |
| 4 prepare an outline to show one's ideas in a sequential and logical relationship. | 2.3 | 2.1 |
| 5 construct a well developed paragraph with main idea plus examples or reasons. | 2.6 | 2.7 |
| 6 write different types of paragraphs, e.g., paragraphs of detail, description, comparison and contrast, narration, explanation, definition, reasoning, argument and persuasion or analogy. | 2.4 | 2.2 |
| 7 make clear transitions between paragraphs so that a logical relationship is drawn. | 2.5 | 2.5 |
| 8 construct sentences of varied types (simple, compound, complex). | 2.5 | 2.0 |
| 9 write sentences that are not only grammatically correct but also logical and coherent. | 2.8 | 2.7 |
| 10 support one's opinions or conclusions, including the appropriate use of evidence. | 2.7 | 2.8 |
| 11 write sentences with precise and appropriate words, to distinguish between literal and figurative uses of language, and to avoid ineffective jargon or cliches. | 2.5 | 2.4 |
| 12 vary one's vocabulary and sentences for different audiences and purposes. | 2.3 | 1.7** |
| 13 synthesize information from a number of different sources. | 2.3 | 2.3 |
| 14 present one's own ideas as related to, but clearly distinguished from, the ideas of others. | 2.2 | 2.4 |
| 15 distinguish between plagiarism and documentation. | 2.4 | 2.6 |
| 16 provide adequate documentation in the form of end notes or footnotes and bibliographical references. | 2.0 | 1.8 |
| 17 use a dictionary. | 2.4 | 2.2 |
| 18 use library resources efficiently. | 2.0 | 1.9 |
| 19 identify and locate the appropriate reference books for various kinds of information. | 2.0 | 1.8 |
| 20 use or follow the conventions of standard written English (relative freedom from such errors as fragmented, run-together sentences, faulty agreement, and improper pronoun reference) and of mechanics (capitalization, spelling, and punctuation. | 2.6 | 2.5 |
| 21 critically assess one's writing and to revise, restructure and rewrite where ideas are poorly organized, or where supporting evidence is lacking. | 2.7 | 2.2** |
| 22 proofread one's writing for mechanical errors and omissions of form, and to make necessary corrections. | 2.7 | 2.1** |

*Natural Sciences not included since only 4 respondents considered writing relevant to success in their classes.
**Difference in means significant, $p<.05$.

Table 3A. Mean rating of the importance of specific speaking/listening skills for entering freshmen by academic division.

| SPEAKING/LISTENING SKILLS | Humanities N=31 | Natural Sciences N=13 | Social Sciences N=23 |
|---|---|---|---|
| *The ability to* | | | |
| 1 engage critically and constructively in the exchange of ideas, especially during class discussions and conferences with instructors. | 2.6 | 2.0 | 2.3* |
| 2 ask questions and answer questions coherently and concisely. | 2.7 | 2.6 | 2.6 |
| 3 follow spoken instructions. | 2.6 | 2.8 | 2.5 |
| 4 identify and comprehend the main and subordinate ideas in lectures and discussions. | 2.8 | 2.8 | 3.0 |
| 5 conceive and develop ideas about a topic for the purpose of speaking to a group. | 1.9 | 1.3 | 1.7 |
| 6 make a clear presentation of one's ideas before a group. | 2.1 | 1.5 | 1.7 |

*Humanities and Natural Sciences differ significantly. $p<.05$

Table 4A. Mean rating of the importance of specific reasoning skills for entering freshmen by academic division.

| REASONING SKILLS | Humanities N=30 | Natural Sciences N=19 | Social Sciences N=23 |
|---|---|---|---|
| *The ability to* | | | |
| 1 recognize and use inductive and/or deductive reasoning. | 2.5 | 2.7 | 2.4 |
| 2 recognize fallacies in reasoning. | 2.2 | 2.6 | 2.4 |
| 3 draw reasonable conclusions from information presented in written or spoken form. | 2.8 | 2.6 | 2.9 |
| 4 draw readonable conclusions from information presented in tabular or graphic form. | 2.0 | 2.6 | 2.3 |
| 5 comprehend, develop, and use concepts and generalizations. | 2.5 | 2.7 | 2.9 |
| 6 distinguish between fact and opinion. | 2.6 | 2.4 | 2.6 |
| 7 identify and formulate problems, along with the ability to propose and evaluate ways to solve the problems. | 2.1 | 2.2 | 2.1 |
| 8 hypothesize or predict outcomes from partial information and then test the hypotheses, | 1.9 | 2.0 | 1.7 |
| 9 assess completeness or adequacy of information whether the text's or one's own. | 2.2 | 2.0 | 2.4 |
| 10 distinguish between observation and inference. | 2.2 | 2.2 | 2.3 |

Table 5A. Mean rating of the importance of specific study skills for entering freshmen by academic division.

| STUDY SKILLS | Humanities N=31 | Natural Sciences N=17 | Social Sciences N=25 |
|---|---|---|---|
| *The ability to* | | | |
| 1 set study goals and priorities consistent with stated course objectives and one's own progress. | 2.7 | 2.7 | 2.6 |
| 2 establish surroundings and habits conducive to learning independently. | 2.6 | 2.8 | 2.5 |
| 3 identify the important points in a lecture and take clear, well-organized notes. | 2.7 | 2.8 | 2.8 |
| 4 follow a study schedule that provides for completion of both short- and long-term projects. | 2.7 | 2.4 | 2.4 |
| 5 interact with and learn from peers (for example in study groups). | 2.2 | 2.1 | 1.9 |
| 6 locate and use resources external to the classroom (computers, libraries, interviews and direct observation) and to incorporate knowledge from such sources into the learning process. | 2.2 | 1.8 | 1.8 |
| 7 develop and use general and specialized vocabularies and use them for reading, writing, speaking, listening, computing and studying. | 2.4 | 2.3 | 2.3 |
| 8 understand and follow instructions for various types of academic assignments. | 2.7 | 2.7 | 2.6 |
| 9 comprehend, recall, summarize, and report the main ideas from reading, lectures, and other academic experiences. | 2.7 | 2.9 | 2.8 |
| 10 apply knowledge and learning concepts to new situations. | 2.5 | 2.6 | 2.6 |
| 11 prepare for and take various types of examinations. | 2.5 | 2.5 | 2.5 |
| 12 accept constructive criticism and learn from it. | 2.6 | 1.9 | 2.3* |

*Difference between Humanities and Natural Sciences significant. $p<.05$

Table 6A. Mean rating of the importance of basic arithmetic skills for entering freshmen by academic division.

| BASIC ARITHMETIC SKILLS | Natural Sciences N=17 | Social Sciences N=12 |
|---|---|---|
| *The ability to* | | |
| 1 perform computations with whole numbers. | 2.5 | 2.9* |
| 2 apply percents. | 2.7 | 2.8 |
| 3 translate situations and verbal problems into mathematical statements. | 2.7 | 2.2* |
| 4 round off and approximate numbers. | 2.5 | 1.9* |
| 5 solve problems having exponents and square roots. | 2.7 | 1.6* |
| 6 use and interpret graphs and tables. | 2.8 | 2.8 |
| 7 understand and use basic arithmetic properties. | 2.9 | 2.7 |

*Difference between Natural Sciences and Social Sciences significant. $p<.05$

Table 7A. Mean rating of the importance of beginning algebra skills for entering freshmen by academic division.

| BEGINNING ALGEBRA SKILLS | Natural Sciences N=17 | Social Sciences N=12 |
|---|---|---|
| *The ability to* | | |
| 1 perform arithmetic operations with literal symbols. | 2.5 | 2.2 |
| 2 solve linear equations. | 2.5 | 1.7* |
| 3 work with ratios and proportions. | 2.6 | 2.1 |
| 4 perform operations with integer exponents. | 2.6 | 1.5* |
| 5 perform operations with polynomials and rational expressions. | 2.1 | 1.2* |
| 6 factor. | 2.1 | 1.4* |
| 7 solve quadratic equations by factoring and formula. | 1.8 | 1.2* |
| 8 use formulas to find area and perimeter of common geometric figures. | 2.1 | 1.4* |
| 9 solve elementary word problems. | 2.5 | 1.8* |

*Difference between Natural Sciences and Social Sciences significant. $p<.05$